

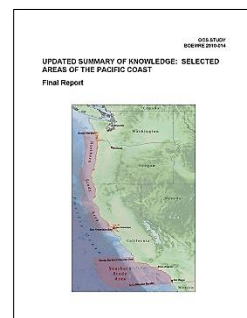
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Information Synthesis & Socioeconomic Studies

Completed (2010) — Updated Summary of Knowledge: Selected Areas of the Pacific Coast

This study by Mangi Environmental Group compiled and analyzed information generated after 1977 about the coastal and marine environment from Grays Harbor, Washington to San Francisco Bay, and from Santa Barbara County to the U.S.-Mexico border. It identified early information and data gaps about oceanographic resources and potential impacts of offshore renewable energy development.

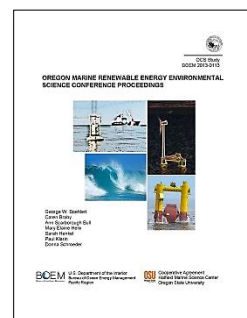
Report (BOEMRE 2010-014): <https://www.boem.gov/ESPIS/4/4955.pdf>



Completed (2013) — Oregon Marine Renewable Energy Environmental Science Conference

This conference – coordinated by and held at Oregon State University, Corvallis – brought together an international group (including 40 Oregon specialists) to review existing and ongoing science pertinent to marine renewable energy. This expert group reviewed existing research and prioritized data gaps and needs for baseline conditions, environmental effects, and monitoring studies.

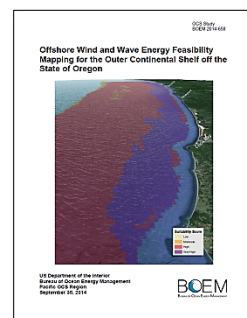
Report (BOEM 2013-0113): <https://www.boem.gov/ESPIS/5/5255.pdf>



Completed (2014) — Industry Feasibility Mapping for the Outer Continental Shelf off the State of Oregon

This study by the U.S. Department of Energy/Pacific Northwest National Laboratory developed maps and other spatially explicit products to identify general areas where it may be technologically and economically feasible to site renewable energy devices on the Oregon Outer Continental Shelf (OCS). It examined the latest industry technologies for offshore wind and wave energy for the Oregon OCS.

Report (BOEM 2014-658): <https://www.boem.gov/2014-658/>

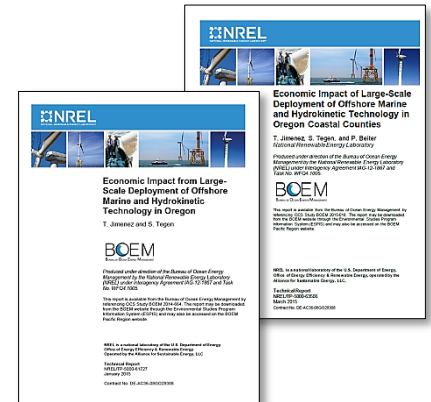


Completed (2015) — Economic Impact from Large-Scale Deployment of Offshore Marine and Hydrokinetic Technology in Oregon

This study by the U.S. Department of Energy/National Renewable Energy Laboratory conducted an analysis of the potential economic impacts of deploying wave energy conversion devices off the coast of Oregon. It examined multiple deployment scenarios to estimate economic impacts for the entire state and Oregon's coastal counties.

First Report (BOEM 2014-664): <https://www.boem.gov/2014-664/>

Second Report (BOEM 2015-018): <https://www.boem.gov/BOEM-2015-018/>

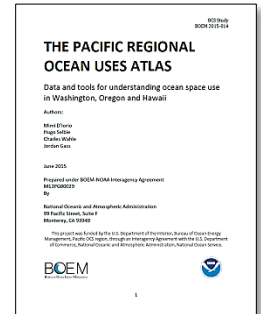


Completed (2015) — Pacific Regional Ocean Uses Atlas

This partnership between BOEM and the National Oceanic and Atmospheric Administration documented patterns of existing and emerging ocean uses in OCS areas off the states of Washington, Oregon, and Hawaii through participatory mapping workshops. The project also identified potential areas of conflict and/or compatibility between proposed renewable energy areas and other ocean uses. The atlas documents a full range of human activities and sectors in the ocean to support offshore renewable energy planning.

Report (BOEM 2015-014): <https://www.boem.gov/2015-014/>

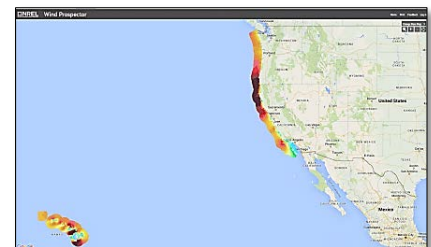
Project Information: <https://marinecadastre.gov/oceanuses/>



Completed (2015) — Pacific Offshore Time Series Wind Resource Analysis

This study by the U.S. Department of Energy/National Renewable Energy Laboratory (NREL) addressed time-series analysis of wind speed data along the coasts of Washington, Oregon, California, and Hawaii, scaled to BOEM's aliquot grid (a unit of leasing). Average wind speed is provided by month, by hours of the day, and for a long-term (17-year) time series. Data are available through Wind Prospector, NREL's web-based GIS application, which provides easy access to wind resource datasets and supports resource assessment and exploration associated with wind development.

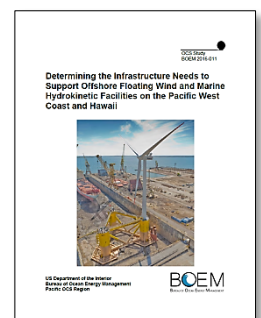
Data: <https://maps.nrel.gov/wind-prospector/>



Completed (2016) — Determining the Infrastructure Needs to Support Offshore Floating Wind and Marine Hydrokinetic Facilities on the Pacific West Coast and Hawaii

This study by ICF International evaluated the current infrastructure and vessel requirements and capabilities existing on the Pacific West Coast of the U.S. and the Hawaiian islands of Oahu, Maui, and Kauai to support the burgeoning offshore renewable energy industry. Understanding the infrastructure needs of the offshore renewable industry will help to identify the port-related requirements for offshore floating wind development and marine hydrokinetic industries and assess the utilization of the available marine equipment and facilities along the U.S. West Coast.

Report (BOEM 2016-011): <https://www.boem.gov/ESPIS/5/5503.pdf>



Completed (2016) — Floating Offshore Wind in Oregon: Potential for Jobs and Economic Impacts from Two Future Scenarios

This study by the U.S. Department of Energy/National Renewable Energy Laboratory conducted an analysis of potential employment and economic impacts of large-scale floating offshore wind off the coast of Oregon. It examined two deployment scenarios to estimate impacts for the entire state and Oregon's coastal counties.

First Report (BOEM 2016-030): <https://www.boem.gov/2016-030/>

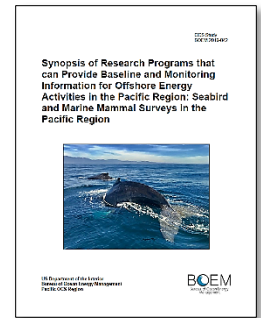
Second Report (BOEM 2016-031): <https://www.boem.gov/2016-031/>



Completed (2019) — Synopsis of Research Programs that can Provide Baseline and Monitoring Information for Offshore Energy Activities in the Pacific Region

This study by the U.S. Geological Survey identified research programs that have produced databases containing information on species and habitats sensitive to offshore energy activities in the Pacific Region. It evaluated the capability of these programs to provide baseline and monitoring data to understand and mitigate potential impacts of conventional energy development offshore southern California and renewable energy development offshore southern California, Oregon, Washington, and Hawaii.

Report (BOEM 2019-042): <https://www.boem.gov/2019-042/>



Completed (2019) — Oregon Offshore Wind Site Feasibility and Cost Study

This study by the U.S. Department of Energy/National Renewable Energy Laboratory (NREL) assessed the present and future costs of floating offshore wind technology deployment at five reference sites in the state of Oregon at commercial scale. The study builds off a 2016 NREL report assessing floating offshore wind costs in California. The Oregon study includes floating offshore wind technology advancement since the California study, recent European and U.S. market data, and cost differences between floating and fixed-bottom offshore wind foundations. The study provides the state of Oregon with site analysis and cost data to allow for consideration of floating offshore wind in the state's future energy portfolio.

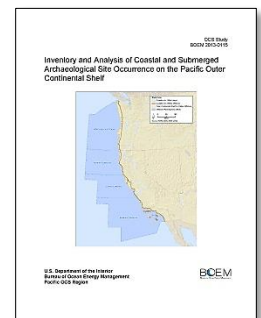
Report (BOEM 2019-046): *in press*

Cultural & Archaeological Studies

Completed (2013) — Inventory and Analysis of Coastal and Submerged Archaeological Site Occurrence on the Pacific OCS

This study by ICF International assessed the potential for submerged prehistoric sites on the California, Oregon, and Washington Outer Continental Shelf (OCS), and identified coastal properties and significant coastal cultural resources subject to potential visual impacts from offshore energy development. It also produced a proprietary inventory of known, reported, and potential historic shipwrecks.

Report (BOEM 2013-0115): <https://www.boem.gov/ESPIS/5/5357.pdf>



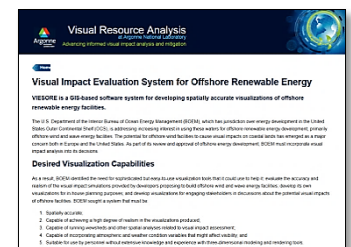
Completed (2014) — Renewable Energy Visual Evaluations

This study by the University of Arkansas and Argonne National Laboratory developed a GIS-based landscape-visualization tool to assess the potential viewshed effects from offshore renewable energy facilities. Visualizations included wind energy structures, lighting, and meteorological conditions.

Journal Article: <http://visualimpact.anl.gov/offshorevitd/docs/OffshoreVITD.pdf>

Overview: <http://visualimpact.anl.gov/viesore/>

Webinar: <https://www.boem.gov/Science-Exchange-5/>



Completed (2017) — Characterizing Tribal Cultural Landscapes

This study by the National Oceanic and Atmospheric Administration used three case studies from Native American communities in California, Oregon, and Washington. It developed a methodology and process that may help all coastal tribes determine significant archaeological and cultural resources. This information will likely be important to future consideration of marine renewable energy projects.

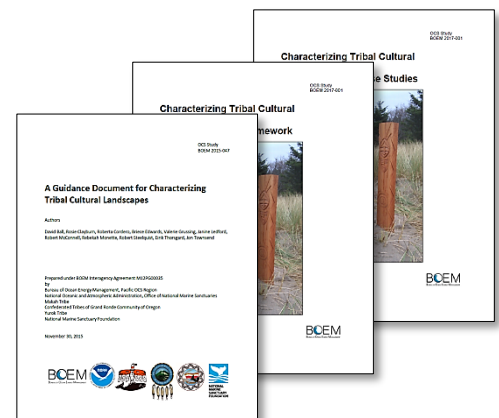
Guidance Document (BOEM 2015-047): <https://www.boem.gov/2015-047/>

Report (BOEM 2017-001):

Volume I: <https://www.boem.gov/BOEM-2017-001-Volume-1/>

Volume II: <https://www.boem.gov/BOEM-2017-001-Volume-2/>

Webinar: <https://www.boem.gov/Science-Exchange-8/>



Ongoing (to be completed 2021) — Archaeological and Biological Assessment of Submerged Landforms off the Pacific Coast

This study by San Diego State University is identifying potential submerged landforms offshore southern California and central Oregon that could indicate the presence of prehistoric archaeological sites. It will also develop a model to identify and classify potential cultural landforms from existing remote sensing data and seafloor maps in areas along the Pacific Coast, and determine if the submerged features are associated with ecologically sensitive areas.

Study Profile: <https://www.boem.gov/pc-14-04/>

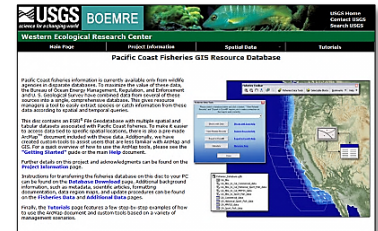
Fact Sheet: <https://www.boem.gov/PC-14-04-Fact-Sheet/>

Biological Studies

Completed (2010) — Pacific Coast Fisheries GIS Resource Database

This study by the U.S. Geological Survey compiled marine fisheries and coastal spatial data from various wildlife agencies in California, Oregon, and Washington and integrated it into a single, comprehensive GIS-based system. The database includes information about Pacific Coast fish, fisheries, and active fishing, as well as southern California seabirds and marine mammals.

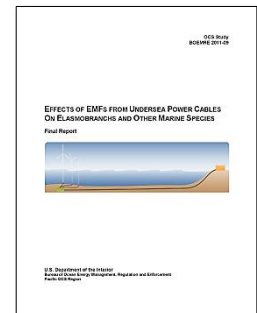
Database: <https://www.usgs.gov/centers/werc/science/pacific-coast-fisheries-gis-resource-database>



Completed (2011) — Effects of EMF from Undersea Power Cables on Elasmobranchs and Other Marine Species

This study by Normandeau Associates synthesized data and information about subsea power-transmission cables and the sensitivity of marine organisms to electromagnetic fields (EMF) produced by the cables. It produced a database of information about potentially affected species of elasmobranchs (sharks and rays), other fishes, marine mammals, sea turtles, and invertebrates. It also recommended future research priorities and potential mitigation measures.

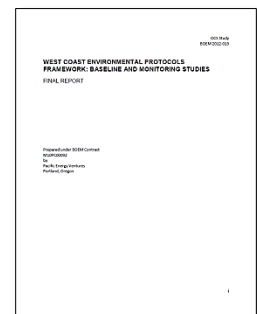
Report (BOEMRE 2011-09): <https://www.boem.gov/ESPIS/4/5115.pdf>



Completed (2012) — West Coast Environmental Protocols Framework: Baseline and Monitoring Studies

This study by Pacific Energy Ventures provides a framework for identifying natural resources and ecological issues to monitor for proposed wave, tidal, and offshore wind projects along the U.S. West Coast.

Report (BOEM 2012-013): <https://www.boem.gov/ESPIS/5/5219.pdf>



Completed (2014) — Survey of Benthic Communities Near Potential Renewable Energy Sites Offshore the Pacific Northwest

This study by Oregon State University provided baseline information about the seafloor environment and the types and distribution of benthic invertebrates in areas of potential renewable energy development on the Washington, Oregon, and northern California OCS. Knowledge of species-habitat relationships will allow for prediction of seafloor communities beyond those sampled in this study.

Report (BOEM 2014-662):

Volume 1: <https://www.boem.gov/ESPIS/5/5453.pdf>

Volume 2: <https://www.boem.gov/ESPIS/5/5454.pdf>

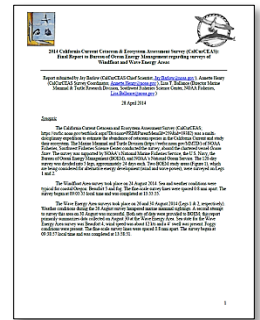
Webinar: <https://www.boem.gov/Science-Exchange-4/>



Completed (2014) — Marine Mammal, Seabird and Ecosystem Data Collection in Pacific OCS Areas off Oregon

This oceanic field survey by the National Oceanic and Atmospheric Administration performed detailed observations of marine mammals, seabirds and ecosystem conditions off Oregon in August/September 2014. Specifically, these short-term, sequential surveys covered the Outer Continental Shelf (OCS) lease blocks for the Pacific Marine Energy Center South Energy Test Site (PMEC-SETS) and WindFloat Pacific, with overlapping, edge-to-edge transects. The methodology used visual, passive acoustic, water and other sampling protocols that have been used for over 10 years off the West Coast and allow for data integration and comparisons.

Synopsis: <https://www.boem.gov/PR-14-OBS/>

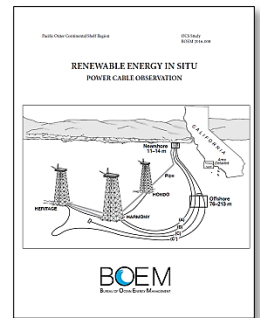


Completed (2016) — Renewable Energy in situ Power Cable Observation

This study by the University of California, Santa Barbara measured the strength and variability of electromagnetic fields (EMF) along subsea power transmission cables in the Santa Barbara Channel, which are similar to cables used for offshore renewable energy inter-device electrical connections. It also compared fish communities in cable versus natural habitats and determined the potential effectiveness of cable burial as a mitigation measure to decrease EMF.

Report (BOEM 2016-008): <https://www.boem.gov/ESPIS/5/5520.pdf>

Webinar: <https://www.boem.gov/Science-Exchange-3/>



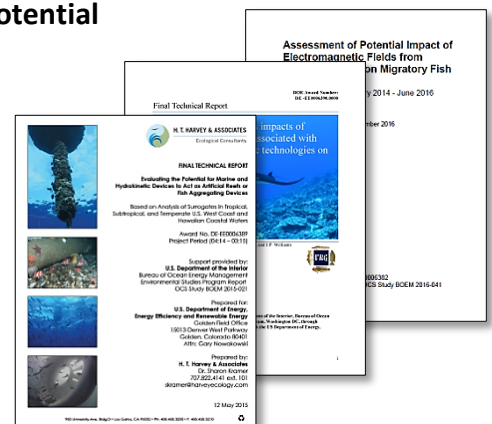
Completed (2016) — Using Ongoing Activities as Surrogates to Predict Potential Ecological Impacts from Marine Renewable Energy

BOEM and the U.S. Department of Energy partnered on this study to identify and analyze data from ongoing projects and activities (surrogates) with stressors and receptors similar to those expected from marine renewable energy projects. Two reports examined potential impacts of electromagnetic fields from operating power cables, and one examined mooring configurations of offshore surrogates such as aquaculture facilities and oceanographic buoys as fish attracting devices.

First Report (BOEM 2015-021): <https://www.boem.gov/2015-021/>

Second Report (BOEM 2015-042): <https://www.boem.gov/2015-042/>

Third Report (BOEM 2016-041): <https://www.boem.gov/2016-041/>



Completed (2016) — Developing and Applying a Vulnerability Index for Scaling the Possible Adverse Effects of Offshore Renewable Energy Projects on Seabirds on the Pacific OCS

This BOEM-directed study, conducted and primarily funded by the U.S. Geological Survey, developed a comprehensive database to evaluate 81 marine bird species in the California Current System (CCS) in terms of their collision and displacement vulnerability from offshore wind energy infrastructure. It used existing and newly analyzed at-sea behavioral information (e.g., avian habits and activities, flight-height, and flight characteristics) and population metrics to identify species-specific vulnerabilities at the population level. The vulnerability assessment results can now be combined with recent marine bird at-sea distribution and abundance data for the CCS to help address seabird conservation during the siting and operation of offshore wind energy development projects.

Report (USGS OFR 2016-1154, BOEM 2016-043): <https://pubs.er.usgs.gov/publication/ofr20161154>

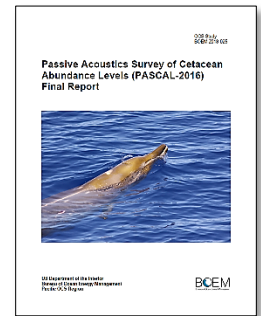
Webinar: <https://www.boem.gov/Science-Exchange-6/>



Completed (2018) — California Current Cetacean and Ecosystem Assessment Survey and Use of Data to Produce and Validate Cetacean and Seabird Density Maps

This study by the National Marine Fisheries Service/Southwest Fisheries Science Center focused on listening for whale species that are difficult to detect during visual surveys because of their deep diving habits and and limited surface activity.

Report (BOEM 2018-025): https://espis.boem.gov/final%20reports/BOEM_2018-025.pdf

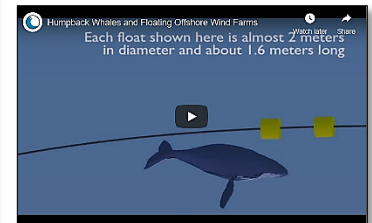
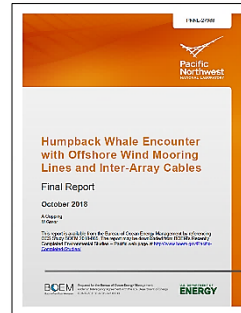


Completed (2018) — Humpback Whale Encounter with Offshore Wind Mooring Lines and Inter-Array Cables

This study by the U.S. Department of Energy/Pacific Northwest National Laboratory compiled information about whale movements (e.g., dive depths and swimming speed) and created a three-dimensional video animation of how whales may move through a hypothetical offshore floating wind farm. This visual simulation will help characterize the risk of whale encounters with mooring lines and electrical cables used in offshore floating wind projects.

Report (BOEM 2018-065): <https://www.boem.gov/BOEM-2018-065/>

Video Animation: <https://www.boem.gov/Humpback-Whales-Floating-Wind/>



Ongoing — BOEM-MARINE (Multi-Agency Rocky Intertidal Network)

This long-term and continuing study by BOEM and a network of partners provides for the monitoring of rocky intertidal habitats and communities at 32 coastal sites adjacent to existing and potential OCS energy development in California and Oregon. Site-specific data about the diversity and abundance of invertebrates are housed in a publicly available database that can be used to monitor intertidal communities.

Study Profile: <https://www.boem.gov/pc-15-02/>

MARINE Website: <https://www.MARINE.gov>



Ongoing (to be completed 2019) — Seabird and Marine Mammal Surveys off the Northern California, Oregon and Washington Coasts

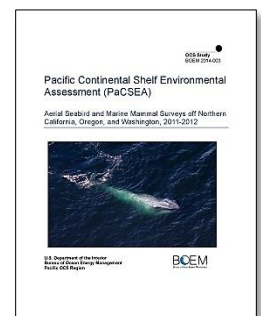
This study by the U.S. Geological Survey and U.S. Fish and Wildlife Service provided up-to-date information on the types, distribution, abundance, seasonal variation, and habitat use of marine mammals and seabirds along the northern California, Oregon, and Washington coasts. Aerial surveys using state-of-the-art technology focused on the most likely areas of OCS renewable energy development. Additional work will determine ecosystem connections and species-habitat associations.

Study Profile: <https://www.boem.gov/pc-10-05/>

First Report (BOEM 2014-003): <https://www.boem.gov/ESPIS/5/5427.pdf>

Second Report: in press

Webinar: <https://www.boem.gov/Science-Exchange-1/>



Ongoing (to be completed 2019) — Data Synthesis and High-resolution Predictive Modeling of Marine Bird Spatial Distributions on the Pacific OCS

This study by the National Oceanic and Atmospheric Administration and U.S. Geological Survey is synthesizing 50 years of seabird survey data off California, Oregon, and Washington, and combining it with information about environmental and oceanographic conditions to predict the occurrence and abundance of seabirds at sea. The resulting predictive maps of seabird distributions will provide critical information for renewable energy siting and evaluation of potential environmental effects of management actions and project approvals.

Study Profile: <https://www.boem.gov/pc-15-01/>

Ongoing (to be completed 2019) — Year-round and Diel Patterns in Habitat-use of Seabirds off Oregon

This study by Oregon State University and the U.S. Geological Survey will provide information about the distribution, movements and behaviors of Oregon seabirds and identify patterns in their habitat use 24/7. New data collected with state-of-the-art tracking devices will be integrated with existing data to map and predict the distribution of species and their potential vulnerability to renewable energy devices.

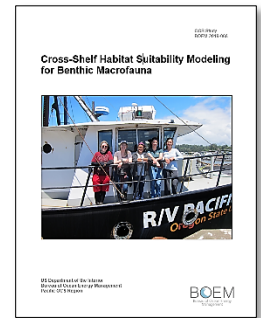
Study Profile: <https://www.boem.gov/pc-14-03/>

Ongoing (to be completed 2020) — Cross-Shelf Habitat Suitability Modeling

This study by the National Oceanic and Atmospheric Administration and Oregon State University (OSU) is expanding the geographic scope of and validating the BOEM/OSU habitat suitability model. The study will improve the applicability of the model to a wider depth range on the continental shelf and improve its predictive capabilities.

Study Profile: <https://www.boem.gov/pc-15-07/>

First Report (BOEM 2019-068): in press



Ongoing (to be completed 2020) — Analysis of Long-term Seabird Colony Legacy Data in the Pacific Northwest as a Regional Baseline

This study by the U.S. Fish and Wildlife Service is summarizing data regarding the abundance and distribution of birds in seabird breeding colonies along the coasts of Oregon and Washington. It will provide an environmental baseline against which to evaluate potential effects of offshore energy projects on seabird colonies and populations.

Study Profile: <https://www.boem.gov/pc-16-06/>

Ongoing (to be completed 2021) — Pacific Marine Assessment Partnership for Protected Species (PacMAPPS)

This study is a partnership between BOEM, the National Marine Fisheries Service, and the U.S. Navy to conduct shipboard surveys of marine mammals, seabirds, and sea turtles in the Pacific. The data collected will help BOEM evaluate potential effects of proposed energy activities on protected species in an ecosystem-level context, including in areas of interest for renewable energy development (California, Oregon, and Hawaii) and for conventional energy decommissioning (California). Surveys of the Hawaiian Islands were conducted in 2017 and surveys of the California Current Ecosystem (Baja California, California, Oregon, and Washington) were conducted in 2018. Additional surveys of the Hawaiian Islands are scheduled for 2020.

Study Profile: <https://www.boem.gov/pc-17-04/>

Ongoing (to be completed 2021) — Potential Impacts of Submarine Power Cables on Crab Harvest

This two-part research effort is to learn more about whether the electromagnetic fields (EMF) emitted from subsea power-transmission cables may affect the movement and harvest of commercial crab species. The first part was conducted by the University of California, Santa Barbara, which collected data on red rock crab in the Santa Barbara Channel and Dungeness crab in Puget Sound. The second part will collect and analyze additional data, and is scheduled to begin in 2020.

Study Profile 1: <https://www.boem.gov/pc-14-02/>

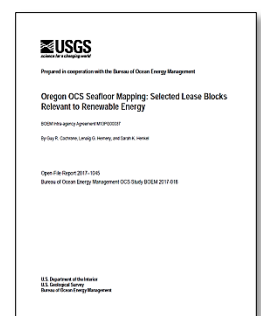
Study Profile 2: <https://www.boem.gov/pc-19-02-profile/>

Physical Oceanography & Geology Studies

Completed (2017) — Oregon OCS Seafloor Mapping: Selected Lease Blocks Relevant to Renewable Energy

This study by the U.S. Geological Survey collected high-resolution, multibeam seafloor data of the potential Outer Continental Shelf (OCS) lease area offshore Coos Bay, Oregon. The data were used to develop comprehensive maps of seafloor habitats and geology, which are needed to address site-specific siting, ecosystem assessments and geohazards.

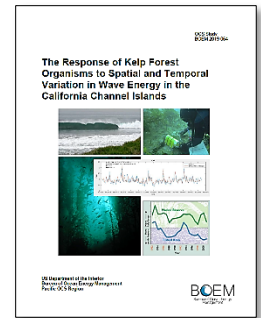
Report (USGS OFR 2017-1045, BOEM 2017-018): <https://www.boem.gov/2017-018/>



Completed (2019) — Predicting the Consequences of Wave Energy Absorption from Marine Renewable Energy Facilities on Nearshore Ecosystems

By calibrating a regional wave model with site-specific wave measurements and site-specific biological data (30+ year time series from the National Park Service and the U.S. Geological Survey offshore southern California), this study developed a statistical model to predict the potential effects of wave energy absorption from marine renewable energy facilities on nearshore ecosystems, especially giant kelp forests. The study found that wave energy had a significant effect on several species. But for most taxa (36/57), density was unrelated to waves. Even for those species with a statistical relationship between density and wave energy, a 15% reduction in wave height would not have a detectable effect on the density of any species.

Report (BOEM 2019-064): <https://www.boem.gov/2019-064/>



Ongoing (to be completed 2020) — Earthquake, Landslide, Tsunami and Geo-Hazards on the U.S. Offshore Pacific Wind Farms

Floating offshore wind (FOW) construction and operation on the U.S. West Coast may face the risk of potential geohazards, as they are relatively new applications of older technologies (land-based wind and mobile offshore drilling units) in tectonically active regions. Seismic activities, landslides, and tsunamigenic earthquakes are threats to the U.S. West Coast and Hawaii, and uncertainty exists over how FOW development and siting will be impacted by these threats in proposed areas of development. This study will provide both a general evaluation of geohazards for floating wind areas already designated as potential lease sites and develop design considerations and criteria for structures to cope with extreme events.

For more information about BOEM-funded research:

Environmental Studies Program: <https://www.boem.gov/Studies/>

Pacific OCS Region Environmental Studies: <https://www.boem.gov/Pacific-Studies/>

Environmental Studies Program Information System (ESPIS): <https://marinecadastre.gov/espis/#/>

Renewable Energy Research: <https://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Renewable-Energy/Renewable-Energy.aspx>